

## CRUISE REPORT<sup>1</sup>

**VESSEL:** *Oscar Elton Sette*, Cruise 04-04 (OES-13) (Fig. 1)

**CRUISE PERIOD:** 21 March- 9 April 2004

**AREA OF OPERATION:** U.S. Line Islands: (Jarvis Island, Palmyra Atoll, and Kingman Reef)

**TYPE OF OPERATION:** Personnel from the Coral Reef Ecosystem Division (CRED), Pacific Island Fisheries Science Center (PIFSC), National Marine Fisheries Service (NMFS), NOAA, conducted coral reef assessment/monitoring and mapping studies in waters surrounding the U.S. Line Islands of Jarvis, Palmyra, and Kingman.

### ITINERARY:

16-21 Mar Start of cruise. *Oscar Elton Sette* arrived Pago Pago Harbor, Tutuila, American Samoa to complete OES-04-03. Began reloading of CRED items stored at harbor facility. Embarked Robert Schroeder (fish). Craig Musburger (fish) and Kyle Hogrefe (towboard/habitat) remained onboard from previous leg. CRED Research Vessel *AHI* (Acoustic Habitat Investigator) reloaded onto *Sette* for transit back to Honolulu. Loaded fuel drums. Embarked Megan Moews (benthic habitat mapping), Mark Readdie (fish), Kim Page (algae), Linda Preskitt (algae), Jean Kenyon (coral), Jim Maragos (coral), Scott Godwin (invertebrates), Ron Hoeke (oceanography), Kevin Wong (oceanography), Jamie Gove (oceanography), Joe Laughlin (towboard/fish), Marc Lammers (benthic habitat mapping/bioacoustics), Russell Moffitt (data management), Alex Wegmann (terrestrial), Mark Rauzon (terrestrial), Stephani Holzwarth (towboard/fish), and Molly Timmers (towboard/habitat). Departed Pago Pago Harbor 21 March at 0900 en route to Jarvis Island. Conducted shipboard orientation meeting for all scientists. Conducted ship's fire and abandon ship drills.

22-25 Mar Transit to Jarvis Island. Conducted dive safety management meeting (including accident reporting requirements); new scientists experienced decompression chamber. Scientists set up computer work stations and network and prepared field survey gear and equipment. Fish and benthic rapid

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<sup>1</sup> PIFSC Cruise Report CR-05-004  
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ecological assessment (REA) teams met and worked out site selections for Jarvis. Arrived Jarvis ~ 2300.

- 26 Mar Conducted six towed-diver habitat and fish surveys around most of the island and three fish and benthic REA surveys on the E and N sides. Deployed four subsurface temperature recorders (STRs) and recovered old/deployed new ocean data platform (ODP). Night ops conducted six deep conductivity-temperature-depths (CTDs) around the island. Drop-off too steep to conduct tethered optical assessment device (TOAD) surveys around Jarvis. U.S. Fish and Wildlife Service (FWS) terrestrial survey team of two went ashore to spend the night and conduct dusk/dawn bird surveys.
- 27 Mar Conducted five towed-diver habitat and fish surveys and three fish and benthic REA surveys on the S and W sides. Fish REA and Tow teams collected fish specimens (as per permit). Deployed new sea surface temperature (SST) buoy and retrieved old anchor from lost buoy; completed 34 shallow water CTDs around island. Picked up two terrestrial biologists from island. Night ops included deep CTDs around the island and three bioacoustic lines. Departed Jarvis for Palmyra.
- 28 Mar Transited to Palmyra. Scientists drafted reports summarizing preliminary findings at Jarvis. Bioacoustic echosounder data on the deep scattering layer were collected intermittently during the transit.
- 29 Mar *Oscar Elton Sette* arrived at Palmyra ~1000 and launched boats. FWS team went ashore late AM for an extended stay. REA teams completed two stations (one a permanent transect) surveying fish, corals, algae, and invertebrates. Fish team collected specimens. Tow team completed five fish/habitat tows along the S. Mooring team recovered an STR in SE backreef (“coral gardens” site) and replaced it with a new one; deployed a subsurface temperature recorder (STR) off SE corner of island and conducted 16 shallow conductivity-temperature-depths (CTDs) along S side. During night, conducted tethered optical assessment device (TOAD) surveys on W bank, deepwater CTDs, and bioacoustics lines.
- 30 Mar REA teams surveyed three stations to SW of atoll. Fish team collected about 2 dozen more fish specimens for genetic analysis. Tow team completed six tows along the western bank. Mooring team deployed a new Coral Reef Early Warning System (CREWS) buoy in the lagoon, retrieved the previous CREWS buoy from shore, and conducted nine shallow CTDs. FWS team continued work ashore. Night ops included TOAD, deepwater CTDs around the atoll, and bioacoustic lines.
- 31 Mar REA teams surveyed three sites - two in SE and one on W (large bumphead parrotfish [*Bolbometopon muricatum*] sighted in “coral gardens” station). Tow team completed four tows along the N and W sides (all divers required to be out of water from 1300-1500 for ship’s crew to conduct NOAA proficiency dives; and also had some engine trouble). Mooring team completed 18 CTDs outside

the atoll and deployed one STR. Depths contour along SE and E sides too irregular and steep to permit safe TOAD operations.

- 1 Apr REA teams conducted surveys on S side and far NW terrace (winds continued too strong for REA teams to work the N and NE sides of atoll). Tow-team completed all planned tows around the outside of atoll, except along the high surf zone eastern side. Daytime bioacoustics baseline transects ran for Palmyra. Mooring team conducted 12 CTDs around the atoll and in the lagoon, plus radiometer readings in lagoon. Night ops included deep-water CTDs and bioacoustic lines. Terrestrial survey team member M. Rauzon returned to the ship after successfully completing his work ashore; other member (A. Wegmann) remained on Palmyra to conduct long-term thesis research.
- 2 Apr Transited from Palmyra to Kingman (arrived ~ 0730). REA teams surveyed sites along the S arm - two outside and one inside. Tow team completed six tows along S and part of W arms outside barrier reef. Mooring team exchanged settling plates on CREWS-buoy anchor in SE corner of lagoon and placed a STR there, retrieved current meter from the S pass channel, and placed a STR there and conducted nine CTDs along the inside of the E arm. No TOADable depths found at Kingman. Bioacoustics and deep CTDs around outside of atoll conducted during night operations.
- 3 Apr REA teams surveyed two sites inside the SE corner of atoll (both permanent transects) and one site inside the S island (inner reef slope). Tow team completed six tows on E side (three outside and three inside the NE). Mooring team conducted 23 CTDs along the S side (inside and out) and placed two STRs. Terrestrial team searched for amphipods on small island along NE arm. Night CTDs ended early as ship's CTD winch experienced mechanical problems.
- 4 Apr REA teams surveyed backreef slope along NE arm and two patch reefs (one a permanent transect) inside lagoon. Tow team completed six tows inside lagoon, which completed resurveys of all previous year's tows at Kingman. Mooring team conducted 13 CTDs and placed several STRs, both inside and outside the atoll. Ship conducted two bioacoustic baseline lines during daytime. In evening conducted two deep CTDs from ship - one on NW and one on N. Completed all field surveys for the cruise, with addition of several bioacoustic lines to be run intermittently during the transit home. Ship departed Kingman Atoll for Honolulu at ~2130.
- 5-9 Apr Transited to Honolulu. On 9 April, between 0000 and 0500, an opportunistic bioacoustic transect was conducted along the Waianae coast of Oahu in waters between the 10- and 50-fathom isobaths. Baseline acoustic backscatter data from the local mesopelagic boundary community were collected to provide a comparison with the data obtained from other locations surveyed during the cruise.

Table 1: Cruise summary statistics for the U.S. Line Islands.

**CRUISE SUMMARY STATISTICS (US Line Islands):**

<b>Field Activity</b>	<b>Jarvis Island</b>	<b>Palmyra Atoll</b>	<b>Kingman Reef</b>
Towed Diver Fish/Habitat Surveys	10	21	18
Fish REAs	6	10	9
Benthic REAs	6	10	10
CREWS buoy recovery/deployment	0	1	1 (recov.)
ODP recovery/deployment	1	0	0
SST buoy recovery/deployment	1	0	1
STR deployments	4	4	5
TOAD drop camera surveys	0	20	0
Aanderaa current meter recovery	0	0	1
Settlement/recruitment plate recovery/ deployment	1 (depl.)	1	1
Shallow water Radiometer casts	0	9	5
QTC acoustic habitat surveys	0	20	0
Bio-acoustic transects (hr)	12	18	12
Deepwater CTDs	13	12	8
Shallow water CTDs	35	55	45
SCUBA dives	87	145	133

**MISSIONS AND RESULTS:**

- A. FISH: Used established quantitative methods (belt-transect, SPCs, REAs) to estimate fish stock biomass and fish species richness, respectively, at habitat-representative stations, to contribute to an expanded baseline assessment and implement monitoring for temporal changes. This was the first year SPCs were conducted throughout the U.S. Line Islands. Select specimens were collected for genetic analysis as requested by collaborators (by permit). (See Appendix A.)

Totals of 6, 10, and 9 stations were resurveyed (monitoring) by the 3-diver Fish REA Team at Jarvis, Palmyra, and Kingman, respectively. Our general impression was that fish assemblages were basically similar to those found on previous CRED cruises at all three reefs, quite healthy with a significant apex predator present at most sites. Common families included sharks, rays, squirrelfish, groupers/anthias, jacks, snappers, butterflyfish, angelfish, damselfish, wrasses, parrotfish, and surgeonfish. The total numbers of fish species observed in 2004 were 171 at Jarvis, 209 at Palmyra, and 165 at Kingman. At Jarvis, small planktivores (e.g., *Anthias*) were very abundant, especially along the W side and on the SE reef terrace. Sharks (mostly gray reef and white tips) were also common here. At Palmyra, large fish were abundant but less so than at Jarvis. At Kingman, fish assemblages generally remain healthy, however, overall fish density, for both small and especially large fish appeared lower than before, with some exceptions. An average of only about one or two sharks were seen during

each dive, compared to about a dozen sharks observed on a typical REA dive 2 yr ago. Select fish specimens collected for genetic analysis totaled 34 at Jarvis, 68 at Palmyra, and 55 at Kingman.

- B. CORALS: Conducted surveys to document the species composition, abundance, percent cover, size distribution, and general health of the shallow water corals in the U.S. Line Islands. (See Appendix B.)

Totals of 6, 9, and 9 stations were resurveyed (monitoring) by the Coral REA Team at Jarvis, Palmyra and Kingman, respectively. Visual estimates of percent live cnidarian cover ranged from 5% to 75%. In general, corals remained healthy, or were recovering, except on exposed, storm-impacted N or E sides. The total numbers of stony coral genera observed in 2004 were 20 at Jarvis, 36 at Palmyra, and 37 at Kingman. The lower value for Jarvis reflects the lack of atoll-type reef habitat. At Jarvis, *Pocillopora* and *Montipora* dominated, each genus contributing more than 20% of the total number of coral colonies. At Palmyra, the genera *Pocillopora*, *Porites*, and *Pavona* dominated, each contributing >10% of the total number of colonies. The eastern reef pool site, “coral gardens,” continues to have high diversity and lush proliferation of *Acropora* corals. At Kingman, *Fungia* and *Porites* dominated, each genus contributing 42% and 23% of the total number of colonies, respectively. Coral communities remain healthy and diverse, despite heavy predation observed in 2004 from the crown-of-thorns seastar *Acanthaster*.

- C. ALGAE: Used quantitative photoquadrat sampling method to collect species composition and baseline abundance data of reef algae in the U.S. Line Islands to compare with previously collected qualitative samples. (See Appendix C.)

Totals of 6, 10, and 10 stations were surveyed by the Algae REA Team at Jarvis, Palmyra, and Kingman, respectively. Red turf and crustose coralline algae were very common at each of the U.S. Line Islands visited with an average occurrence in photoquadrats of 95.4% for turf and 89.6% for crustose coralline. At Palmyra and Kingman, the most abundant frondose algae were multiple species of *Halimeda* occurring in 70.8% and 71.3% at the respective islands. Jarvis was characterized by a high abundance of the encrusting brown alga *Lobophora variegata* which occurred in 69.44% of the photoquadrats. *Dictyosphaeria cavernosa* as well as an unidentified orange encrusting alga were common at Palmyra occurring in 26.4% and 65.6% of the photoquadrats, respectively. At Kingman Atoll, *Microdictyon* sp. was a dominant macroalga occurring at 34.26 % of the sites visited.

- D. INVERTEBRATES: Surveyed non-coral marine invertebrate fauna to assess their relative abundance and monitor of reef communities to identify changes. This is accomplished through procedures that quantify a set of target organisms and build a species inventory to document biodiversity. (See Appendix D.)

At Jarvis, populations of macroinvertebrates were diverse and abundant and remain healthy since last surveyed in 2002. The unique set of oceanographic conditions at this island allow more than adequate larval recruitment and primary

productivity to support such assemblages of mobile and sessile reef invertebrates. Palmyra Atoll's wealth of habitats supports varying degrees of macroinvertebrate diversity. Giant clams (*Tridacna maxima*) were generally not very abundant, except on the shallow sheltered "coral gardens" reef. Crown-of-thorns starfish (*Acanthaster planci*) were rarely seen. A focused survey for marine alien marine invertebrate species was conducted within the lagoon. Alien species found included a hydroid (*Pennaria disticha* [confirmed]), and two species of sponge (suspected). Kingman Reef exhibits an extreme abundance and diversity of macroinvertebrate species within all forereef, backreef, and patch reef habitats; all populations appeared intact and undisturbed by man. The giant clams *Tridacna maxima* (most common) and *Tridacna squamosa* were present in all habitats surveyed, most dense on lagoon patch reefs. Echinoderms were also common throughout the atoll, represented by all classes (except crinoids); greatest abundance was on lagoon reefs. The crown-of-thorns starfish was recorded at all survey sites, suggestive of a high potential for large outbreaks in the near future.

- E. **TOWED-DIVER SURVEYS:** Used benthic and fish towed-diver survey methods in the U.S. Line Islands to provide a general description of reef habitat, macroinvertebrates, and reef fishes over a large spatial scale. The methods provided assessments and the foundation for monitoring large-scale disturbances and general distribution and abundance patterns of macroinvertebrates and reef fishes over 50 cm total length. (See Appendix E.)

Totals of 11, 21, and 18 towed diver surveys were conducted around Jarvis (20 km), Palmyra (41 km), and Kingman (39 km), respectively. Benthic Observations: Habitat surveys found 0.1%, 0.7%, and 1.5% of the corals to be pale in appearance at these three reefs, respectively. Few conspicuous macroinvertebrates were found at Jarvis and Palmyra, no crown-of-thorns, and only few giant clams at Palmyra. However, at Kingman crown-of-thorns were abundant (~50 COT/tow; a 66% increase over 2002 surveys). About 15% of the corals appeared white from likely predation. Also at Kingman, over 25,000 giant clams (*Tridacna* sp.) were observed, 85% in the southeast backreef lagoon, composing nearly 50% of the benthic substrate here. Soft corals were observed in a few places (e.g., sites of storm damage) at Jarvis and Palmyra, while they dominated the forereef on two sides of Kingman. Fish Observations: The twin spot snapper (*Lutjanus bohar*) was the most commonly observed fish, larger than 50 cm TL at all three reefs. Also common were gray reef shark (*Carcharhinus amblyrhynchos*), rainbow runner (*Elagatis bipinnulata*), and pacific steephead parrotfish (*Chlorurus microrhinos*). At Jarvis, blacktongue unicornfish (*Naso hexacanthus*) and blackfin barracuda (*Sphyrna genie*) were also common. At Palmyra several large (>3 m TL) giant hammerhead shark (*Sphyrna mokarran*) were seen and a large (>4 m TL) tiger shark (*Galeocerdo cuvier*) was sighted at Kingman.

- F. **OCEANOGRAPHIC SURVEYS:** Conducted near and offshore oceanographic surveys and deployed a variety of surface and subsurface oceanographic instruments in the U.S. Line Islands with the goal to quantify and assess and gain a better understanding of the overall hydrographic environment near these islands. (See Appendix F.)

At Jarvis, strong flow of the Equatorial Undercurrent (EUC) past the island results in upwelling of cold water on the western side. This injection of cold, nutrient rich water likely has important ecological impacts on the local coral reef ecosystem. Preliminary analysis of shallow water CTD data shows generally warm (27.0 to 27.3°C) and well mixed waters to the SE, E, and N sides of Jarvis. Temperature profiles showed signs of upwelled west and southwest EUC waters in 2004 (i.e., 0.3 to 0.7°C colder than surrounding waters).

At Palmyra, preliminary analysis of shallow water CTD shows surrounding waters to have a mean temperature of 28.0°C and mean salinity of 34.7 PPT. Waters were generally well mixed and extremely clear (transmissivities >80%), except in the lagoon.

Kingman Reef has no significant emergent reef or land and its lagoon appears to be extremely well flushed. Preliminary analysis of shallow water CTD shows surrounding waters are extremely well mixed, with a mean temperature of 28.1°C and mean salinity of 34.6 PPT; all transmissivities were greater than 80%. Except for small sheltered areas of the lagoon, CTD characteristics inside the reef or relic lagoon were nearly indistinguishable from those outside the lagoon, which leads to the assumption that Kingman Reef's lagoonal waters are nearly pelagic most of the time. Maximum recorded temperatures reach approximately 30.2°C and minimum temperatures are approximately 27.5°C.

- G. NIGHT SURVEYS: Towed Optical Assessment Device (TOAD) to videotape portions of the seafloor, and QTC (benthic acoustic signature) data were collected at Palmyra, but not at Jarvis or Kingman, due to steeply dropping depths adjacent to the shallow reefs. The ship's acoustic doppler current profiler (ADCP) was still not functioning. Conductivity-temperature-depth (CTD) casts and bioacoustic (echosounder) lines were conducted (See Appendix G).

At Jarvis Island, CTD profiles show characteristic water properties of the EUC with distinctively marked decreases in temperature and dissolved oxygen coinciding with an increase in salinity. The CTD cast to the East of Jarvis exhibited a much different profile. Temperature, dissolved oxygen, and salinity show a homogenization of the upper 100 meters, with a more gradual change in values over the next 50 meters. A nonquantitative assessment of the bioacoustic data revealed a clear diurnal trend in the occurrence of a layer of surface-associated biomass.

At Palmyra Atoll, TOAD was deployed 20 times in conjunction with the QTC data collection. The expansive western bank consisted primarily of extensive amounts of diverse live corals which sometimes alternated with fields of coral rubble and encrusting coralline algae with small patches of live coral. The benthic topography in these areas was rough textured with many overhangs and large coral heads. Most of the CTD data around Palmyra show a decrease in salinity at the surface. A nonquantitative assessment of the bioacoustic data revealed that a dense community of mid-water sound scattering organisms exists around the entire perimeter of the atoll at night. From our observations it can be

speculated that the SW side of the atoll is enriched by nutrients flowing out of the lagoon more so than the other sides. Coincidentally, several observations of melon headed whales (*Peponocephala electra*) were made along this side of the atoll. This species is known to feed primarily on squid, which are typically part of the sound scattering layer.

At Kingman Reef, CTD casts show similar patterns to Palmyra. Kingman profiles show a shallower thermocline starting at ~100 meters. At most of the stations, the salinity tends to be mixed to 100 meters. The most prominent patch was observed along the SW corner of the atoll and coincided with the entrance to the primary channel to the atoll.

The echosounder data collected at the three sites visited reveal that each location is quite distinct in the density and distribution of the mid-water biomass occurring there. Jarvis and Palmyra appear to be much more productive than Kingman. Furthermore, only Palmyra supports a dense, thermocline-associated community. The three locations are quite distinct oceanographically and ecologically. Jarvis is fed by upwelling and is also a major bird colony. Nutrient inputs from these two sources probably contribute to the productivity observed there. Palmyra is a forested network of islets that also supports a significant bird population. Nitrogenous and organic outflows from the terrestrial ecosystem are likely important factors influencing the productivity observed there. Kingman has neither of these major influences, which may explain the lack of sound scattering biomass encountered there.

- H. **TERRESTRIAL SURVEYS:** The terrestrial team conducted pelagic bird and mammal transects during transit between islands. On shore, a standard rapid ecological assessment of the islands were made by counting and staging all active nests of breeding seabirds, counting wintering shorebirds, listing all plant species, and recording their phenological condition as well as looking for other biological phenomena and signs of trespass or introductions of nonnative invasives. (See Appendix H.)

At Jarvis, over 1.5 million birds were counted representing about 19 species. The island was very dry and the vegetation was brown. About 100-150 bottlenose dolphins were seen around the atoll. The health and growth of bird populations here may be related to the oceanic upwelling around the island that promotes their planktonic food sources.

At Palmyra, over the past decade, there has been a rapid decline of its (previously undisturbed) *Pisonia* rainforest caused by an infestation of a scale insect. As the *Pisonia* forest declined and the dense shade provided by the canopy eliminated, dense undergrowth of fern and sprouting palm nuts may change the microclimate of the forest floor. The forest ecology is jeopardized by the loss of the giant trees. It remains unknown what effect this loss will have on reef nutrient enhancement around the atoll.



At Kingman Reef, only the eastern tip of the reef is above water, and there are two small isles (few 100 m<sup>2</sup> each) composed of clamshell and coral rubble. About six species of birds were sighted.

#### **SCIENTIFIC PERSONNEL:**

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#### **DATA COLLECTED:**

Fish REA numerical and biomass densities by species  
Fish specimens for genetic analysis  
Digital images of fish-habitat associations  
Target REA macroinvertebrate counts  
Macroinvertebrate voucher specimens  
Algal voucher specimens  
Algal REA field notes of species diversity and relative abundance  
Digital images from algal photoquadrats  
Quantitative towboard surveys of large fish species (>50cm TL)  
Digital video surveys of fish from towboard transects  
Benthic composition estimations from towboard surveys  
Macroinvertebrate counts from towboard surveys  
Digital images of the benthic habitat from towboard surveys  
Habitat lineation from towboard surveys

Videos of the deeper benthic habitats/biota from TOAD operations  
QTC (benthic acoustic signature) data  
Shallow-deep conductivity, temperature and depth (CTD) profiles  
Bioacoustic (echosounder) transects of sound-scattering layers  
Terrestrial bird and mammal surveys

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Attachments

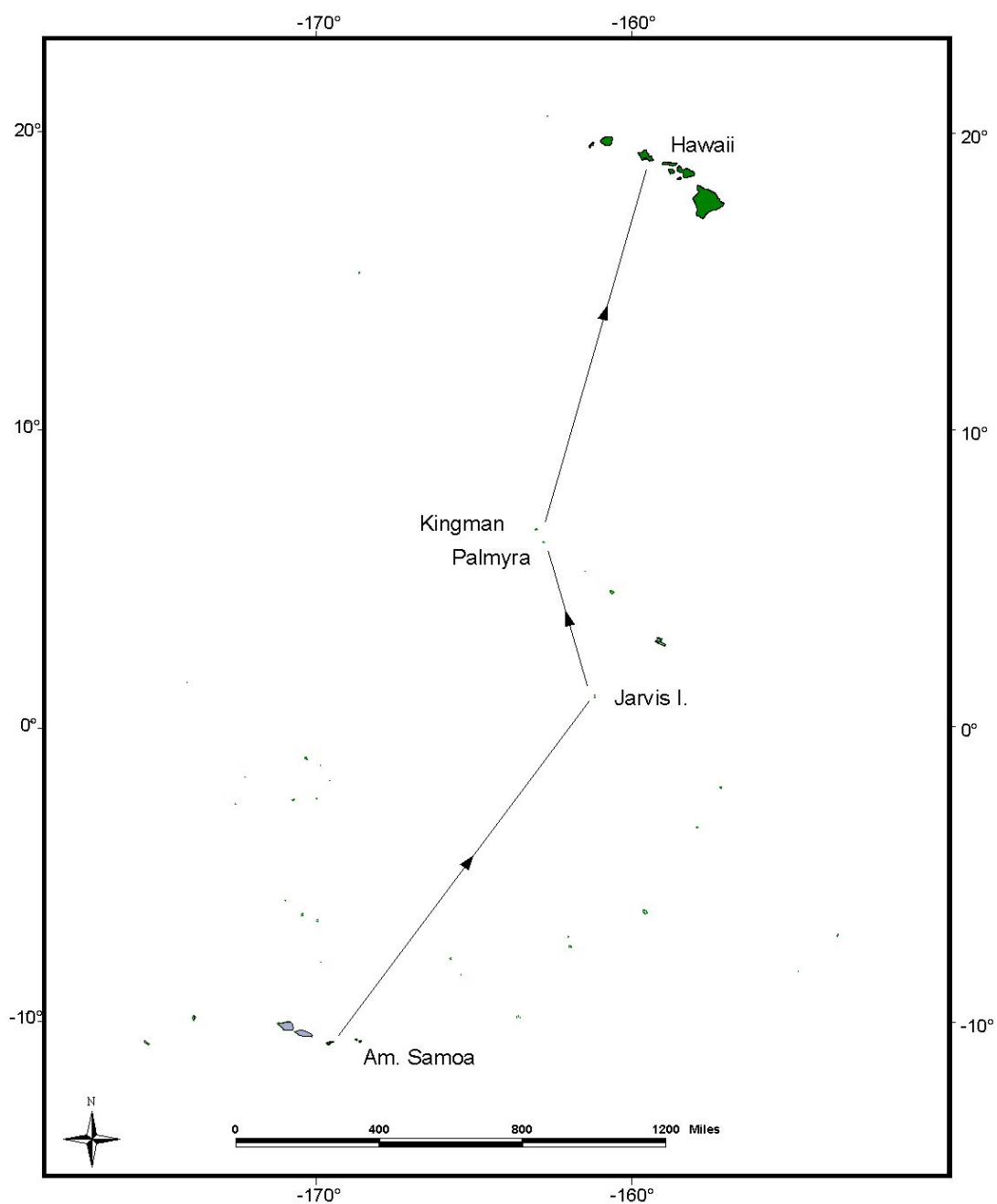


Figure 1. *Oscar Elton Sette* cruise track through U.S. Line Islands, 21 March-9 April, 2004.

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